SCIENCE

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SCIENCE[1]

By Dr. F. R. MOULTON

PERMANENT SECRETARY OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

A FEW weeks ago I read an interesting article on the enormous increase in the population of the world during the past two or three centuries. In that very brief interval the number of living human beings increased perhaps fivefold. Simply as a biological phenomenon this extraordinary growth in population in the course of fewer than a dozen generations raises interesting questions respecting causes and equally interesting ones respecting consequences.

Of the continents, Europe is by far the most densely populated, with an average of about 130 inhabitants per square mile. Then follows Asia, in which the hordes of India and China give an average of about 60 per square mile. Even in India there are only 177 persons per square mile, or about one third the population density of Great Britain, while China is less densely populated than Illinois. The average population density of North America is about 19 per square mile; in both Africa and South America it is approximately 11 inhabitants per square mile, while in Australia it is only 2.2 persons per square mile.

Several factors have undoubtedly contributed to the recent remarkable increase in world population, but it is probable that the most important of them has been the application of science. This conjecture is supported by the fact that, except in those cases in which migrations have been major factors, populations have shown the greatest increases where the applications of science have been most abundant. It is also supported by the fact that on the whole the densest populations are where science finds its highest development.

In recalling the amazing increase in human population of the globe in the past few generations and in suggesting that the increase is probably due in large

[1] Abbreviated from an address delivered before the Lancaster, Pa., Branch of the American Association for the Advancement of Science.

measure to applications of science, I am not expressing an opinion as to whether the phenomenon has been desirable or undesirable. I have no settled conviction that setting aside "the law of the survival of the fittest" by preserving and protecting the unfit will in the long run prove advantageous to the race. I have no theory that the luxuries, which are enjoyed by those who through science command the materials and forces of nature, are for their good. I simply point out that something startlingly new and extremely important is happening in the world.

It is easy to give striking illustrations of applications of science which have transformed the world. For example, the coal that is burned in the United States each day does more mechanical work than all men in the country do in a year. A ton of freight is carried a mile on the railways at a total cost to the shipper which would buy the time of an unskilled laborer for only a minute or two. A motor car, its materials gathered from all over the world and transformed into precision parts, costs less per pound than to send letters from one town to another. A 60-watt electric light is operated for almost an hour at a cost to the user of the federal tax on just one cigarette. By means in everyday use, a whisper in London can be heard in Chicago. But illustrations of the efficiency of the applications of science always fall far short of making us really understand the miracles that are being performed. One reason is that for countless generations the minds and imaginations of our race have practiced on things within the reach of our unaided hands and eyes. It can not be expected, therefore, that in a generation or two we should have acquired the power to comprehend what science is doing.

Since up to the present science has been concerned largely with material things, both inanimate and animate, we are likely to attempt to measure its importance in terms of physical phenomena. I have spoken of the efficiency of our machines. If I had chosen illustrations from the biological fields, I would have referred to the remarkable results that have been obtained from the breeding of plants and animals and in the curing of disease. Yet in the long run by far the most important consequences of science will be its effects upon our minds. For the moment I am not referring simply to such increases in knowledge as have taken place since our ancient ancestors began their ascent from the level of primitive cave men. I refer rather to revolutions in points of view and habits of mind, such as many times in the history of the world have resulted from causes which were much less important than recent science and its applications. Let me refer to one of them which is distant enough to be seen in fair perspective. When Columbus crossed the Atlantic and Magellan sailed around the earth, the accepted foundations of the physical universe were shaken; when Copernicus and Galileo advanced compelling reasons for believing that the earth is relatively a particle of matter flying in a vast orbit about the sun, those foundations were destroyed. That the revolution in point of view was profound is proven by the fact that it led to bitter controversies for nearly three centuries.

When we consider the bitterness and the length of the controversy over the question of the motions of the earth, we are quite likely to think that it was the most important intellectual revolution that ever has taken place or ever will take place. Such a conclusion is quite unfounded, I think. Certainly the ideas of Copernicus and Galileo had little, if any, direct effects upon the work and the ways of living of the world. They raised no physical burdens from the backs of men. They did not banish the specter of hunger and disease that had always lurked in the shadows of the night. They contained no new reason why a person should love his neighbor as himself. They promised no new paradise for the pure in heart. They simply tumbled man from the proud position he had assumed for himself at the summit of creation.

On the other hand, the doctrine of organic evolution is as important from the practical point of view as it is far-reaching in its philosophical implications. Though it places man in the general stream of life, it provides sound principles for developing the lower forms for his good. Though it chastens him with the story of his humble origin, it points equally to the inspiring heights to which there is a possibility of his ascending. If it were as easy to explore all the vast domain of organic evolution as it is to understand the heliocentric theory of the solar system, the work of Darwin and his successors would already have completely revolutionized our ways of thinking. But the theory of organic evolution involves all the infinite variety of the life of the present, and ties it in with that of the long geologic past. Instead of being not much more than a rather simple geometric diagram, it is a fabric woven from all the strands of life into marvelous patterns which are as yet little understood.

Up to the present I have spoken of science as though it consists of theories which gradually win their way in the minds of men. That tacit assumption may be correct so far as scientists are concerned, but the great mass of human beings are moved by simpler considerations. They respond primarily to physical things—to shelter and food and the comforts of life. Yet the fact that these comforts may be abundantly enjoyed only as a consequence of ten thousand applications of science will gradually transform the point of view of mankind. Perhaps the transformation will not be fully on the level of the conscious mind, but will consist of a

general mass psychology of which there have been many strange examples. If this condition of which I speak shall ever be attained, it will undoubtedly be over a long and winding trail, for the factors at work are many and increasing in number. The goal is, of course, an intellectual and moral world in tune with the uniformities which we know as "the laws of nature." That goal transcends in importance every other objective of science, and scientists will, I hope and believe, give it more and more attention.

In speaking of the ultimate goal of science, I do not, of course, think that scientists should attempt to hitch their wagon only to a very distant and perhaps unattainable star. There are many intermediate objectives worthy of their attention. For example, I think that scientists should very often consider science in the broader aspects of its effects upon human beings. It has sometimes been suggested that scientists should undertake to settle the problems of economics and sociology and government by the methods which they have found effective in the natural sciences. But it is probable that in those strange and wholly different fields workers in the natural sciences would be about as incompetent as politicians would be in a chemical laboratory. It would be unsafe to assume that they are masters of methods that are fundamentally different from those which other intellectually honest men attempt to use in much more difficult fields. It would be even more unsafe to assume that, as compared with men in business and other professions, they are exceptionally altruistic. The only assured fact is that they are introducing revolutionary factors in the world and, therefore, that they should feel a heavy responsibility for examining the results of what they are doing. With deep humility they should cooperate with men in other fields to discover how society may best use the titanic forces which they are placing at its command. They should do this thoughtfully and persistently lest that which so far has on the whole been good should eventually turn out on the whole to be bad.

In certain respects the steep trail science has been traveling in recent decades must soon change to a gentler slope. For example, the number of scientists in the United States has been increasing at a much higher rate than its total population. If the present geometric rate of increase of the names included in "American Men of Science" should continue even for only 150 years, this biographical book would contain sketches of the lives of more scientists than there will probably be persons in the United States at that time. In a comparable period the publication of papers on biology or chemistry would use up the printing capacity of the land. At that time a biologist or a chemist would have to spend several months each year even to glance over an abstract of *Biological* or *Chemical Abstracts*. The biologists and the chemists would have to be in continual convention in a hundred centers in order to present brief digests of their investigations. To operate their electrical equipment physicists would use more energy than all of industry and transportation. Evidently these things would not happen. Science is now in the rapidly growing springtime of its existence. Its roots are in fertile soil and its branches are rapidly pushing out in all directions. Instead of attempting the impossible task of stopping its growth for a period, as England's "gloomy dean" has proposed, it will be better to direct its development so that its fruit shall be good. This is why I am urging that scientists consider carefully the effects of what they are doing.

It is probable that scientists do not generally realize that in an exceptional way they stand upon the shoulders of their predecessors and that for this reason their progress is exceptionally rapid. A scientific principle once established becomes the property of all science; a piece of apparatus once constructed becomes a pattern for later apparatus of the same kind. But not to the same degree is a work of art or a moral principle or even a social order a stepping stone for its successor. For example, there has been more improvement in electric lights in a decade than there has been in literature since the time of Shakespeare. There has been a greater advance in our knowledge of the body of man in this generation than there has been of the moral law since the Sermon on the Mount. Beyond the domain of the natural sciences the complexities are enormous. Never are conditions in the humanities even approximately duplicated. Consequently, there do not exist in those fields the simple laws of the natural sciences. Into this complex, little-understood world, in which the minds and emotions of men are paramount factors, the natural sciences are pouring their amazing products. Although each physical product be simple itself, it may multiply enormously the complexity of the already complex social machine. For example, the automobile has created more interdependencies among our people than existed altogether thirty years ago.

There has often been an aloofness on the part of those who work in the natural sciences from the remainder of the world. Sometimes we have heard boasts that the results of an investigation never could be put to a practical use. Although the richest rewards of scientific research are esthetic, the pure joy of discovery, yet that fact does not justify any touch of snobbery on the part of scientists, for other men may get similar pure enjoyment out of the things they do. No one is qualified to say that what he does is in any way more important, except to himself, than what another one may be doing. There is no good reason for think-

ing that the fields of honest endeavor, however much they may differ otherwise, are on essentially different levels.

In view of the complexities and importance of the humanities, they have been given too little attention. When I make this statement, I am not expressing any approval of immature theories respecting the desirability of more numerous social controls. On the contrary, I think that enforced restraints into standardized patterns will destroy our capacity for improvement. I am thinking, rather, of investigations in psychology, economics, political science, social science and related fields from the objective point of view adopted by biologists, for example. I am thinking, too, of industry as not only depending on many sciences, but as being in a real sense science itself. Science pursued in this broad sense will enrich itself and the world. By its example and its influence it will gradually lead us toward the ideal condition in which every man will be worthy of having his name in "American Men of Science."

Here in Lancaster you have formed a Branch of the American Association for the Advancement of Science. In taking this step you have recognized the great importance of science and have committed yourselves to promoting its interests. I am sure that your meetings are not only profitable to your members but are advantageous to your city. I would that there were a hundred similar branches of the association to carry with high purpose and steady hands the enlightening torch of science. If the whole country were similarly organized the American Association for the Advancement of Science would have more than a million members. Then this great democratic organization would be more nearly fulfilling the dreams of those who founded it and of those who have untiringly devoted their energies to its interests.

Although your meetings here in your own branch are pleasant and profitable, I trust you will not neglect the general meetings of the association. In them you will find rich programs of papers by specialists in nearly every field of natural and social science. You will have the inspiration of contacts with the scientific leaders of the country; and I hope that the association will continually increase the opportunities it offers for meeting and hearing addresses by the eminent scientists of the world. These leaders in the fields of science are the real authors of history. Their work is having more fundamental effects than all the laws which have ever been enacted or all the armies that have ever marched in triumph. The benefits that flow from their achievements are not limited by race or creed or political boundaries or even by time. They offer a perfect example of the fact that "it is more blessed to give than to receive." They provide physical comforts for all men and gradually free their bodies from disease and their minds from the terrors of superstitions. They give to their fellow scientists enchanting new views into the regions which they explore. They prepare for posterity a new world in which to live. I hope the American Association for the Advancement of Science will make a more prominent feature of its programs the appearance of heroes of science. I do not express this hope for the sake of the eminent scientists themselves, but for the benefit of those who serve more humbly in the ranks of science, and particularly for those who look at it from afar through the columns of the daily press. Since men are hero worshippers, it is sound policy to exalt those who are the world's real heroes in a fundamental sense. If this is done honestly and effectively, all of us will realize more fully the importance of what science is doing, and we shall more thoughtfully consider its consequences.

In an earlier geological age certain animals grew so large that their unwieldiness led to their extinction. In our day several fields of science have grown so greatly in numbers of workers and in volume of output that they are becoming seriously unwieldy. Although they are not growing toward a condition that will result in their destruction, the difficulties of arranging for their meetings steadily become more and more serious, and the problem of publishing the results of their investigations more and more nearly impossible of satisfactory solution. Naturally, the American Association for the Advancement of Science, which includes nearly all the natural and social sciences, is confronted with similar difficulties. Indeed, if it undertook to do for all the sciences just what the society for each science does for its own members in the way of providing opportunities for the presentation and publication of highly specialized papers, it would be in danger of bogging down into confusion and ineffectiveness. Instead of narrowly traveling this road, it is giving more and more attention to syntheses of science. In particular fields it encourages symposia by competent authorities. The ideal symposium presents the fundamentals of a domain of science in historical and essential perspective. It is quite possible that the American Association for the Advancement of Science will become the most important agency in the country for promoting and publishing symposia. Its organization gives it the broadest opportunities for such undertakings, and it has unequalled advantages for arranging symposia that reach across the boundary lines of related but usually separated fields. It has an opportunity of being a pioneer in the difficult and undoubtedly extremely important problem of bringing the natural, social and industrial sciences into

mutual understanding and close cooperation for the future of civilization. If the association shall profit by the extraordinary examples of efficiency presented by industry, it will organize its varied and enormous resources in membership to make science in a broad sense the brightest light in the world.

In this local gathering there is something of hominess and comfort which we all enjoy. Here is expressed to an exceptional degree this kindly, unselfish spirit of science. But the meetings of the association as a whole are more like an army on the march. They involve masses and administrative machinery and simultaneous movements on a hundred fronts. Yet they can be so organized that each individual who attends them not only will commune with his fellow specialists, but, through addresses by the heroes of science and by symposia, will be raised to heights from which he can survey the field of operations of the great army of which he is a part. Then, in slightly paraphrased words of Byron, he will say at the close of each meeting of the association:

> I love not Nature less, but Man the more,
> From these our interviews, in which I steal
> From all I may be, or have been before,
> To mingle with the Universe, and feel
> What I can ne'er express, yet can not all conceal.

SCIENTIFIC EVENTS

THE OXFORD UNIVERSITY BUREAU OF ANIMAL POPULATION

The first annual report of the Oxford University Bureau of Animal Population is summarized by a correspondent of the London *Times*. He states that the inception of the bureau is due to its present director, Charles Elton, whose researches on the regular fluctuations in numbers shown by many wild animals convinced him of the high theoretical and practical importance of the problem of animal population. The bureau was first established in 1932 with the aid of a grant from the New York Zoological Society and with the general approval of the University of Oxford. A trial period convinced the university authorities of the value of the work, and the bureau is now an official institution, with a grant from the university towards its expenses and a fellowship at Corpus for its director. The correspondent writes:

> The range of contacts established by the bureau is remarkable for what is still a small institution. Their main piece of research, on the fluctuations in numbers of voles, is supported by the Royal Society, the Forestry Commission, the Medical Research Council and the Agricultural Research Council, and there has been cooperation with such different bodies as the Scottish Meteorological Office and the London Zoo. The research on partridge numbers is chiefly financed by Imperial Chemical Industries, with aid from private estate owners throughout the country. A remarkable example of cooperative research is that on the fluctuation of the snowshoe rabbit in the North American continent. For this reports are analyzed from nearly 700 separate observers, from the Hudson's Bay Company, the Canadian National Parks Service, a paper corporation in Anticosti, the Alaska Game Commission, the Newfoundland Department of Natural Resources and the United States Bureau of Biological Survey.
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> Results of this and related inquiries have made it possible to build up a picture of fluctuations in Canadian wildlife for over 100 years. The period of the fluctuation was originally supposed to be determined by the 11-year sun-spot cycle, but the more accurate records now available show that this can not be. The period averages a little less than 10 years, and must be determined by some hitherto undiscovered climatic cycle. That this is likely to be so is shown by the research on vole plagues. The numbers of voles, it was found, fluctuate with a three- to four-year periodicity. Quite recently the superintendent of the Scottish Meteorological Office has discovered a rhythm in factors affecting storminess, which exhibits an identical rhythm that unquestionably (though by what precise means is still unknown) causes the voles' fluctuations. Thus for certain purposes animal numbers may constitute a new type of meteorological instrument, serving to detect hitherto unsuspected weather-cycles.

A side-line undertaken by the bureau is the investigation of the fluctuation in numbers of the semi-wild exotic animals which have been liberated in Whipsnade. The researches of the bureau have great practical importance. If adequate records are available scarcity due to persistent over-destruction can be readily distinguished from the purely temporary scarcity due to a "crash" in a normal cycle of fluctuation. Among the fur-bearing carnivores of Canada, for instance, the lynx and fox show normal cycles; but the marten has been over-trapped and now is no longer able to increase rapidly in numbers at regular intervals as it used to do.

THE MARIA MOORS CABOT FOUNDATION FOR BOTANICAL RESEARCH

The establishment of the Maria Moors Cabot Foundation for Botanical Research is announced by Harvard University. The initial endowment is $615,773, provided by Dr. Godfrey L. Cabot, of Boston, a graduate of Harvard College in the class of 1882. The income from this fund is to be used for the first fifty years for plant research, all restrictions being removed after this period. The purpose of the gift is to investigate methods of increasing the rate of growth of plants, especially trees, and consequently the rate at

which they convert sunlight into cellulose and other vegetable substances. The income will be expended through existing botanical units of Harvard University, and largely through the Harvard Forest at Petersham in cooperation with those associated with the Biological Laboratories, the Bussey Institution and the Arnold Arboretum. Dr. Cabot's gift can be used for direct research, without heavy capital investments for land, library or laboratory facilities.

President James B. Conant said in connection with the announcement of the gift:

The foundation is a first and highly important step toward the creation in Harvard University of a broad and far-reaching program of advanced research and instruction in the whole range of the conservation of natural resources. The current reorganization of the Harvard Forest and the creation of the Harvard Graduate School of Public Administration have sharply focussed the attention of the university on the urgent need and the opportunity for such a program.

A statement made by Dr. Elmer D. Merrill, administrator of botanical collections at the university, reads in part:

The extraordinary achievements in improving the vigor, hardiness and productivity of food plants and of domestic animals by scientific selection and by hybridization are common knowledge. Very little comparable work has ever been attempted in the case of forests, one of our most valuable plant associations. This in part is due to the baffling complexities involved in breeding improved strains of plants with such a long life span as trees, and in part to the fact that mankind has hitherto been able to rely largely on wild forests for timber and cellulose. It is only in the past 150 years that Europe has used intensive forest culture, and only in the past generation that America has made a beginning in that direction. As, however, only about fifteen per cent. of the forests of the world are under scientific cultivation and the rest are being threatened by destructive exploitation, the danger to the world's future supply of wood and cellulose is apparent. One important and promising solution of the problem lies in improving the strains of trees used in the cultivated forests of the world, and it is on that aspect that Harvard University is now enabled to launch a significant research program through the generous gift of Dr. Cabot.

Among those who will be actively engaged on the work at the start will be Professor E. M. East and Professor Karl Sax, who will study the hybridization of trees by artificial pollination in order to evolve more rapidly growing strains. They will attack also the problem of doubling the chromosome numbers in order to increase the size and especially the vigor and hardiness of selected species and to permit reproduction of hybrids by seed instead of by vegetative reproduction.

Professor K. V. Thimann will work on the vegetative propagation of the most promising natural strains, particularly of conifers. Vegetative propagation of trees presents the possibility of a short cut as compared with hybridization, since it permits working with immediately promising natural strains. Professor P. R. Gast, of the Harvard Forest, will continue his present experiments on the effect of controlled quantities of tree nutrients and solar radiation on the growth of trees, and will extend the work to nutritional qualities of natural forest soils and their improvement by the silvicultural treatment of the forest. Professor Gast will also have charge of the selection and propagation of the most promising natural strains of different trees, which are known, in many cases, even in the same species, to vary widely.

SEVENTH ANNUAL FIELD CONFERENCE OF PENNSYLVANIA GEOLOGISTS

THE seventh annual meeting of the Field Conference of Pennsylvania Geologists was held at Bradford, Pa., over the week-end of May 28, 29 and 30. The attendance of fifty-one members and guests included, besides Pennsylvanians, geologists from Connecticut, New Jersey, New York, West Virginia, Ohio and the District of Columbia. The Conference Committee consisted of Professor C. A. Bonine, *chairman,* Professor C. R. Fettke and Stanley H. Cathcart. The local committee was made up by A. C. Simmons and J. C. Martin.

On Friday afternoon an inspection trip was made through the Kendall Oil Refinery, in Bradford, and this was followed by a visit to a lease of the Petroleum Reclamation Company. On Saturday the entire conference participated in a stratigraphic trip in the Bradford district, which was led by Professor Fettke. Strata in the Pennsylvanian, Mississippian and Devonian Systems were examined. These embraced the Mercer shale and coal, and the Olean conglomerate in the Pottsville Series (Pennsylvanian), the Knapp formation in the Mississippian, and the Oswayo, Cattaraugus and Chemung beds in the Devonian.

On Sunday, May 30, the group divided into two parties. Trip A, under the leadership of Dr. Kenneth Caster, spent the day in studying Pennsylvanian, Mississippian and Upper Devonian strata in the area covered by the Warren Quadrangle. The chief interest in the stratigraphic studies in the Bradford and Warren areas is concerned with their relationships to the Bradford and Venango Oil Fields of northwest Pennsylvania. Trip B, led by Professor Henry Leighton, journeyed to Erie, Presque Isle and vicinity to study Pleistocene and Recent shore-line features.

The annual dinner was held at the Emery Hotel in Bradford on Saturday evening. After the dinner, a presentation of local geology was given by Dr. Caster. During a brief business meeting following his talk an invitation from Dr. Arthur Bevan, state geologist of

Virginia, was accepted to hold the eighth annual meeting largely in Virginia. The Field Conference Committee consists of Dr. Arthur B. Cleaves, *chairman*, Professor Frank M. Swartz and Professor R. E. Sherrill.

ARTHUR B. CLEAVES,
Secretary-Treasurer

GRANTS OF THE GEOLOGICAL SOCIETY OF AMERICA

THE following twenty-seven grants in support of special research projects were authorized by the council of the Geological Society of America at a meeting held on April 24.

Maurice Ewing, Bethlehem. Grant of $4,700 covering construction of apparatus suitable for use in work on the deep-sea floor and provision for necessary auxiliary apparatus, and measurement of the thickness of sedimentary deposits beyond the edge of the continental shelf by means of this apparatus.

Alfred S. Romer, Cambridge. Grant of $3,500 covering assistance and incidental expenses involved in compilation of a bibliography of fossil vertebrates.

Edward B. Mathews, Baltimore. Grant of $700 covering assistance and expenses in compiling published chemical analyses of rocks.

Nelson H. Darton, Washington, D. C. Grant of $700 covering field and office expenses in completion of investigation of the overlap relations of Tertiary and Cretaceous formations in eastern Maryland and Virginia.

Bruce L. Clark, Berkeley. Grant of $500 for assistance in completing monograph on radiolarians from the Cretaceous and Eocene of Middle California.

J. T. Rouse, Columbus. Grant of $450 for field and other expenses connected with study of the volcanic rocks and related problems in the Shoshone Mountains, Wyoming.

David M. Delo, Appleton. Grant of $35 for completion of illustrations for a monograph on the North American phacopid trilobites.

Mrs. Helen Tucker Rowland, Ithaca. Grant of $300 covering traveling and office expenses connected with completion of monograph on the Caloosahatchie fauna of Florida.

A. C. Veatch, New York. Grant of $3,000 covering preparation and printing of charts in study of submarine valleys off the Atlantic Coast, beyond the 1,000-fathom line.

Marcellus H. Stow, Lexington, Va. Grant of $665 covering field and office expenses of study of sedimentation and stratigraphy of the northwestern part of the Big Horn Basin and the southern part of the Crazy Mountain syncline, Montana.

Mrs. Margaret F. Boos, Denver. Grant of $350 for field and office expenses of detailed study of granite plutons of the Indian Creek area, Denver Mountain Park.

David T. Griggs, Cambridge. Grant of $900 covering cost of building and installing a hydraulic press needed in further studies of the mechanics of rock deformation under conditions of high pressure and high temperature.

Howard A. Coombs, Seattle. Grant of $400 for field and office expenses of a comparative study of Mts. Rainier and Baker.

Vincent P. Gianella, Reno. Grant of $200 for field and office expenses of investigation of piedmontite mineralization in metamorphosed volcanic rocks near Reno, Nevada.

Ralph W. Imlay, Ann Arbor. Grant of $1,125 covering field and museum study and preparation of manuscript on Upper Jurassic marine faunas of northern Mexico and of certain critical areas for correlation of Jurassic and Lower Cretaceous stratigraphic sections.

Harry N. Eaton, Syracuse. Grant of $100 covering field expenses of study of glacial advances in Allegheny County, New York.

J. Harlan Johnson, Golden, Colo. Grant of $200 for laboratory and office expenses of study of algal limestones of the Upper Paleozoic section in the Rocky Mountain region.

Stuart A. Northrop, Albuquerque, N. Mex. Grant of $300 for traveling, living and office expenses of study of the paleontology and stratigraphy of the Silurian Chaleur series of the Port Daniel-Black Cape region, Gaspe.

George M. Stanley, Ann Arbor. Grant of $315 covering field and office expenses of study of lower Algonquin beaches in the Upper Great Lakes.

Perry Byerly, Berkeley. Grant of $900 for assistance in study of northern California earthquakes, as recorded at the group of stations of the University of California.

Paul D. Krynine, New Haven. Grant of $240 for traveling, field and laboratory expenses of sedimentary study of the Pleistocene deposits of the Bristol Gorge, Connecticut.

A. K. Miller and W. M. Furnish, Iowa City. Grant of $500 covering assistance and office expenses of detailed study of Permian ammonoids of the Guadalupe Mountains and adjacent areas.

Everett C. Olson, Chicago. Grant of $750 covering one half of the traveling and field expenses of an expedition to the Tambla locality, Province of Gracias, Honduras, to collect vertebrate fossils.

Arthur Keith, Washington, D. C. Grant of $500 for field expenses connected with studies of the Appalachian folded belt in the Province of Quebec.

Biological Abstracts, Philadelphia. Grant of $1,500 covering assistance in paleontological service.

T. T. Quirke, Urbana. Grant of $983.50 covering assistance and laboratory expenses of studies directed to the measurement of the index of refraction of opaque or nearly opaque substances by reflection.

W. F. Prouty, Chapel Hill. Grant of $1,000 covering field and other expenses connected with study of the origin of the bays in the Atlantic Coastal Plain area.

RECENT DEATHS AND MEMORIALS

DR. PHILIP B. WOODWORTH, consulting engineer, formerly dean of the School of Engineering of Lewis Institute, Chicago, and president of the Rose Poly-

technic Institute, died on June 7 at the age of seventy-one years.

DR. HIRAM COLVER MCNEIL died on June 8 at the age of seventy years. He was lecturer in chemistry at the George Washington University from 1910 to 1918 and head of the department from 1918 to 1933, when he retired. Dr. McNeil had previously been at various times a member of the U. S. Geological Survey, the Bureau of Chemistry and the National Bureau of Standards.

THE death on June 8 is announced at the age of eighty years of Victor Lieberman, at one time an associate of Louis Pasteur.

EMERITUS PROFESSOR ARTHUR GEORGE PERKIN, of the University of Leeds, distinguished for his work in color chemistry, died on May 30 at the age of seventy-five years. He was the second son of the late Sir William Henry Perkin, founder of the coal tar color industry.

Nature reports the death of J. H. Field, formerly director of observatories in India, on May 19, aged sixty-four years, and of Professor Albert Griffiths, formerly professor of physics in Birkbeck College, University of London, on May 24.

A BRONZE plaque in memory of the late Roger Griswold Perkins has been erected by his friends in the reading room of the department of hygiene and bacteriology of Western Reserve University. Dr. Perkins was professor of preventive medicine from 1910 to 1930 and professor emeritus from 1930 to 1936.

SCIENTIFIC NOTES AND NEWS

DR. EDWARD LAURENS MARK, Hersey professor of anatomy, emeritus, at Harvard University, director of the Zoological Laboratory from 1900 to 1921 and director of the Bermuda Biological Station for Research from 1903 to 1931, attained his ninetieth birthday on May 30. His friends and former students celebrated the occasion by writing letters expressing personal congratulation and appreciation of his important services to biological science. The letters, numbering about a hundred, were collected and substantially bound into a volume, which was informally presented to him on his birthday.

THE retirement in June of Dr. William Webber Ford as professor of bacteriology in the School of Hygiene and Public Health of the Johns Hopkins University is being made the occasion for the presentation of a token of regard from his former students and associates. A number of rare or unusual books in bacteriology and mycology have been chosen for the gift. Among these are early editions of the complete works of Fracastoro, Redi and Spallanzoni and the recently published Icones Farlowianae from Harvard.

DR. PHILIPP LENARD, professor of physics at the University of Heidelberg, celebrated his seventy-fifth birthday on June 7.

DR. G. F. HERBERT SMITH retired from the British Museum (Natural History) on May 26. He joined the staff of the museum in 1897, when he was attached to the mineral department. From 1921 to 1935 he acted as secretary of the museum, returning in the latter year to his original department as keeper.

DR. L. O. HOWARD has been elected an honorary member of the German Entomological Association, Berlin.

AMONG honorary degrees conferred at the hundred and fifth commencement of New York University was the doctorate of science on Dr. Charles Franklin Kettering, president of the General Motors Research Corporation, and the doctorate of public health on Dr. James Alexander Miller, president of the New York Academy of Medicine.

WILLIS R. GREGG, chief of the U. S. Weather Bureau, received on June 7 the honorary degree of doctor of science from Norwich University. Colonel Porter H. Adams, president of the university, made the citation: "To Willis Ray Gregg, meteorologist and executive; chief of the United States Weather Bureau; pioneer in the study of the meteorological problems of aeronautics, who justly is acclaimed as a distinguished contributor to the advancement of the science of meteorology."

PROFESSOR H. H. NININGER, director of the Nininger Laboratory, curator of meteorites in the Colorado Museum of Natural History, Denver, and secretary-treasurer of the Society for Research on Meteorites, has been awarded the honorary degree of doctor of science at the fiftieth annual commencement exercises of McPherson College, Kansas.

MISS WINIFRED GOLDRING, assistant state paleontologist, New York State Museum, Albany, has received the honorary degree of doctor of science from Russell Sage College, Troy, N. Y.

DR. E. V. ALLEN, of the Mayo Clinic at Rochester, Minn., has been elected president of the section for study of peripheral vascular disease of the American Heart Association; Dr. Irving Wright, of the Post-Graduate Hospital, New York, has been elected vice-president, and Dr. Irvine H. Page, of the Hospital of the Rockefeller Institute, New York City, was re-elected secretary-treasurer.

THE officers, executive committee and members of the Division of Geology and Geography, National Research Council, for the year beginning on July 1, are as follows: *Chairman,* Chester R. Longwell; *Vice-chairman,* Robert S. Platt; *Executive Committee,* Chester R. Longwell, Robert S. Platt, Edson S. Bastin, John L. Rich, J. F. Schairer and John K. Wright; *Representatives of Societies,* A. F. Buddington and John L. Rich, Geological Society of America; J. F. Schairer, Mineralogical Society of America; Charles Butts, Paleontological Society; Preston E. James and Robert S. Platt, Association of American Geographers; John K. Wright, American Geographical Society; Edson S. Bastin, Society of Economic Geologists; Robert B. Sosman, American Ceramic Society; F. H. Lahee, American Association of Petroleum Geologists; *Members at Large,* Florence Bascom, Chester R. Longwell and L. F. Thomas.

THE annual meeting of the Royal Society of Canada was held at the University of Toronto from May 25 to 28, under the presidency of Lawrence J. Burpee, of Ottawa, who took as the subject of his presidential address "The Discovery of Canada." During the meeting the Flavelle Medal for scientific research was presented to Dr. Frank D. Adams, the Lorne Pierce Medal for literature to Dr. Stephen Leacock and the Tyrrell Medal for historical research to Aegidius Fauteux. In the three sections devoted to science and their various sub-sections, two hundred and twenty papers were presented. Dr. A. G. Huntsman, consulting director of the Biological Board of Canada, editor of its publications and professor of marine biology at the University of Toronto, was elected president of the society for the year 1937–38.

AT Kansas State College, Dr. A. B. Cardwell has been appointed head of the department of physics, succeeding Professor J. O. Hamilton, and Dr. W. T. Stratton has been appointed head of the department of mathematics, succeeding Professor B. L. Remick. Professors Hamilton and Remick have served on the college faculty since 1900 and will continue teaching for part time.

DR. RICHARD WEISSENBERG, for many years a member of the medical faculty of the University of Berlin, has been appointed visiting professor of cytology at the School of Medicine of Washington University, St. Louis.

DR. WOLDEMAR WEYL has been appointed professor of glass technology at the Pennsylvania State College, effective next January. For the past six years Dr. Weyl has been in charge of investigations on glass at the Kaiser Wilhelm Institut. During the academic year 1936–37 he has been visiting professor at the Pennsylvania State College and has given lectures at the Ohio State University, Princeton University and the University of Illinois. He is at present in Germany.

DR. ROBERT WALLACE VIRTUE, instructor of biochemistry in the Louisiana State University, has been appointed assistant professor of biochemistry at the University of Denver.

DR. R. M. CALDWELL, of the U. S. Bureau of Plant Industry, has been appointed chief of the department of botany, and R. W. Samson has been appointed assistant chief at the Agricultural Experiment Station of Purdue University.

DR. LEON PRATT ALFORD has been appointed professor of administrative engineering and chairman of the department of industrial engineering at New York University to succeed Professor Joseph Wickham Roe, who is retiring as professor emeritus after sixteen years of teaching and administrative service.

DR. HENRY ROY DEAN, master of Trinity Hall and professor of pathology in the University of Cambridge, has been elected to the office of vice-chancellor for the year 1937–38.

T. G. ROSE has been appointed general director of the British National Institute of Industrial Psychology, to collaborate with Dr. C. S. Myers, the principal, who will retain the position held by him since the inception of the institute sixteen years ago.

GRANTS of the Committee on Scientific Research of the American Medical Association have been made to Dr. Fred L. Humoller, assistant professor of physiological chemistry at the Loyola University School of Medicine, for a study on the chemistry of the toxic principle found in culture fluids of *B. enteritidis;* to Dr. Elizabeth Shull Russell, of the Roscoe B. Jackson Memorial Laboratory of Bar Harbor, Me., for a study of the genetics of tumors in the fruit fly, *Drosophila melanogaster;* to Dr. Orthello R. Langworthy, of the Johns Hopkins University, for the study of the effect of ovulation and pregnancy upon the smooth muscle of the urinary bladder; and to Professor Roe E. Remington, professor of nutrition in the Medical College of the State of South Carolina, for the continuation of his work on the metabolism of iodine in the rat.

DR. MAURICE HOLLAND, who is at the head of a delegation that is visiting laboratories in England, Germany and France under the auspices of the Division of Engineering and Industrial Research of the National Research Council, spoke at a luncheon given by the American Chamber of Commerce in London on May 25.

EDGAR BROWN, of the U. S. Department of Agriculture, and Mancel T. Munn, of the State Agricultural

Experiment Station, Geneva, N. Y., have been appointed official delegates of the U. S. Government to the eighth International Seed-Testing Congress at Zurich. The congress will hold its sessions from June 29 to July 4.

DR. Z. KOZMINSKI, of the Wigry Biological Station at Suwalki, Poland, is carrying on research work in limnology at the University of Wisconsin during the month of June. During July and August he will be in residence at the Trout Lake Limnological Laboratory, where he will study the photosynthesis of the phytoplankton and the copepod fauna of the lakes of that district.

DR. HAROLD ST. JOHN, botanist at the Bishop Museum, Honolulu, will sail on June 28 for Fiji to continue the exploration sponsored by the museum of the South Sea Islands. He expects to collect plants for two months, principally on the interior plateau of Viti Levu, which is relatively unknown botanically.

Professor J. G. FITZGERALD, director of the School of Hygiene at the University of Toronto, has a year's leave of absence to study the teaching of preventive medicine in medical schools in the United States, Canada, the British Isles and other countries of Europe for the Rockefeller Foundation. Professor FitzGerald gave a Chadwick Public Lecture in London on May 26. His subject was "Preventive Medicine—an Avenue of Good Will."

DR. C. H. ROBERTSON recently completed a lecture tour of eight chapters of Sigma Pi Sigma, physics honor society, at Miami University, the University of Kentucky, Berea College, the University of Chattanooga, the College of William and Mary, the University of Richmond, West Virginia University and the Ohio State University. The subject of the series was "Gyroscopes and Boomerangs."

SIR ARTHUR EDDINGTON, director of the observatory and Plumian professor of astronomy at the University of Cambridge, gave the eighth annual Haldane Memorial Lecture at Birkbeck College, London, on May 26. His lecture was entitled "The Reign of Relativity, 1915–1937."

THE seventh annual research conference of the department of chemistry of the Johns Hopkins University is being held from June 7 to June 25, at the Cavalier Hotel, Virginia Beach. The subjects are "Enzymes" during the first week, "Phenanthrene Chemistry" during the second week and "The Mechanism of Some Homogeneous Organic Reactions," including oxidation, chlorination and polymerization, during the third week. These conferences provide an opportunity for discussion among a group of specialists in a particular field of chemistry. The meetings are kept as informal as possible, there are no printed papers, and no formal record of the proceedings is kept. It is preferred that attendance be limited to those working in the field under discussion or in closely allied fields, so that the groups may be small enough for each person to take part in the discussion. The conference is under the direction of Professor F. O. Rice, department of chemistry, the Johns Hopkins University, Baltimore, Md.

SIGMA PI SIGMA, physics honor society, installed its thirty-first chapter on May 10 at John B. Stetson University, DeLand, Florida. Dr. Marsh W. White, the Pennsylvania State College, was the installing officer and spoke at the first open meeting of the chapter, following the installation, on "Modern Alchemy."

THE installation of the Illinois Alpha Chapter of the Alpha Epsilon Delta Honorary Premedical Fraternity at Illinois Wesleyan University, Bloomington, was held on May 21. Dr. Emmett B. Carmichael, professor of physiological chemistry at the School of Medicine of the University of Alabama and grand president of the fraternity, conducted the ceremonies which marked the installation of the eighteenth chapter since the establishment of the fraternity at the University of Alabama in 1926.

DISCUSSION

THE EXCESSIVE MEEKNESS OF AMERICAN BOTANISTS

THE meekness of American botanists has been so long and so generally recognized that no comment was offered and certainly no surprise was occasioned when some years ago Seifriz[1] quoted a visiting Swiss botanist as calling attention to the fact that it is easy in most American universities to recognize the botany building, because it is the "oldest building to be seen anywhere." We have, however, taken a certain satisfaction in the feeling that our zoological friends were ready to assert themselves, to think and to act independently, and that thus a fair balance would be maintained, and the general field of biology adequately, if not evenly, cultivated.

Rather recently, however, there has appeared in various quarters the more disturbing suggestion that

[1] *The Scientific Monthly*, May, 1928.

the apparent forcefulness of zoologists is relative only to their botanical associates and that biologists as a group are inclined to be meek and to accept their basic theories and even their methods ready-made and second-hand; moreover, that these hand-me-downs do not really fit. For example, Whitehead[2] says, ". . . at the present moment, the prestige of the more perfect scientific form belongs to the physical sciences. Accordingly, biology apes the manners of physics. It is orthodox to hold that there is nothing in biology but what is physical mechanism under somewhat complex circumstances." To which Russell[3] adds, ". . . Biology, impressed by the success of physical concepts in their own sphere at the time of the great development of the classical mechanics, took over to itself concepts and methods which were clearly inappropriate and inadequate."

Now criticism of this sort is disturbing enough, but after all, we have been believing that most of the workers in any field need not concern themselves with fundamental theory—provided, of course, they are doing their daily duty of accumulating "facts" with proper zeal and appropriate methods. Even this haven of refuge seems now endangered from two distinct angles, one, that the very volume and variety of the accumulated facts make real comprehension more difficult; and the other, that our present methods are as badly suited to our needs as our present concepts. On the first point, witness Crowther,[4] "But the neglect of comprehensive synthesis by which all the facts could be ordered led to intellectual chaos, just as the blind drive to increase production of goods, without working out any comprehensive system of distribution, led to chaos in social life," or Lyon,[5] who says the same thing in medical rather than economic figures. "There is a serious side to this unabsorbed gorge of science. It has given our people a bad indigestion. It lies in the public stomach and troubles their dreams. They do not know enough to know good science from bad." And on the second, Sullivan[6] says: ". . . Discrimination is fatiguing; also it makes appeal to sensibilities which many earnest 'scientific workers' do not possess. It is much easier to make measurements than to know exactly what you are measuring. To give up the ideal of measurability would be the equivalent, to many people, of abandoning 'science' altogether. 'Science is measurement,' we are told. . . . In their eagerness to measure something, our researchers seem to lose their ordinary common sense, whereas their subject really requires the subtlety and sympathy of a very good novelist."

This last challenge is particularly disturbing to our complacency, since it at least suggests that the real foundation of our recently acquired faith in supposedly exact measurement may be found in mental laziness. For botanists—American botanists at least—have at last discovered mathematics and appear cheerfully ready to abandon any form of inquiry or information gathering which does not readily lend itself to measurement and statistical analysis. Like all good converts, we are trying to be more orthodox than the Pope, for the mathematicians are quite ready to concede that there are in biology important fields of inquiry where mathematics can play little part. To quote Carmichael[7]: "It must also be remembered that there are important Chapters of Science which do not come readily under the domain of number. Witness much of biology and in particular the theories of phylogenetic development." Some would go even further. Whitehead[8] agrees with Henri Poincaré in insisting "that instruments of precision, used unseasonably, may hinder the advance of science."

Certainly, within the writer's field of study (plant diseases) there occur phenomena which appear to defy accurate measurement by present methods, yet which seem important and abundantly worthy of record. Reference is here made to the fluctuations in plant disease which are of very great biological interest and economic importance, but which are most inadequately recorded, largely because they do not appear to be readily measurable. That large differences occur no one denies. That they are hard to measure is granted. The essential difficulty of the undertaking is emphasized whenever the accurate measurement of losses from a single plant disease is undertaken. One of the most interesting recent attempts[9] is based on a comparison of the yields of adjacent smutted and smut-free plants of dent corn. In spite of the care used in the field work and in the analysis of results, this work is still open to the criticism that the diseased plants may have become infected because they were different in the first place.

However, a discussion of the methods of measuring disease losses does not belong in this paper. There is no present possibility, even if we had developed the technique, of making measurements of losses due to even the important known diseases of our agricultural crops. Largely on this account, there is a decided, possibly an increasing, reluctance on the part of plant pathologists to record these differences at all. This willingness largely to ignore for purposes of record anything which can not be measured and set down in mathematical terms is, of course, just one more mani-

[2] "Science and the Modern World," p. 144.

[3] "The Interpretation of Development and Heredity," p. 163.

[4] *Soviet Science.*

[5] *Sigma Xi Quarterly,* December, 1936, p. 208.

[6] "Gallio—or the Tyranny of Science," p. 50.

[7] *The Scientific Monthly,* December, 1935, p. 495.

[8] "Adventures of Ideas," p. 311.

[9] I. J. Johnson and J. J. Christensen, *Phytopathology,* 25: 223–233, 1935.

festation of the excessive meekness of American botanists. There may well be biological phenomena, the *record* of whose occurrence is more important than their measurement and which should be recorded even if they can not be measured. For example, only a few years ago, 1931, eel grass (*Zostera marina*) was common in the shallow waters of the Atlantic seaboard, from North Carolina to Nova Scotia—now it is rare. Its diminution was so sudden that no opportunity was given for statistical study, even by the quadrat method. Yet obviously the biologists of the future are entitled to the information that a striking phenomenon occurred in our coastal waters at this period, even if we are not able to furnish figures.

This is, of course, an extreme case, but somewhat similar situations arise over and over again in our consideration of the variations in the incidence of plant diseases. For example, it is biologically and economically important to know that bacterial wilt was exceedingly abundant on sweet corn in the Hudson Valley of New York in 1932 and 1933 and very rare in 1934 and 1935, but whether the loss occasioned in the earlier years was 20 or 40 per cent. and whether the loss in the two later years was one half or three fourths of 1 per cent. is of merely academic interest. In 1932 and 1933 the losses were disastrous, and in 1934 and 1935 negligible.

Nothing could be further from my thoughts than to suggest any radical reform such as would be needed to alter our general professional attitude or develop new concepts and methods particularly suited to the study of living things. I certainly cherish no illusions as to the possibility of securing some slowing down of the rate of accumulation of observations or even a little breathing spell during which we might consider what, if anything, these accumulated facts signify. Quite the contrary, I propose merely that we students of living things shall not restrict ourselves to the type of observation or record prescribed by devotees of other branches of science, but shall record as clearly as we may whatever phenomena seem interesting to us, even though we can not measure them with great accuracy. For such unrestrained self-expression, Dr. Sarton has recently furnished an adequate slogan in his book, "The Study of the History of Science"—"No scientist worth his salt has ever abandoned an investigation simply because the attainable precision was too low."

NEIL E. STEVENS

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"RACES" AND "HOMING" OF SALMON

IN support of the theory of the "homing" of salmon from distant places in the sea, Dr. Willis H. Rich[1] puts forward the argument that the local "races" of the Pacific salmon could not exist if the fish did not return to their own rivers, seeing that large numbers of them travel hundreds of miles in the sea before entering streams. It would appear, however, that the theory of "races" is in somewhat comparable condition to that of "homing" from distant places, in that adequate proof is lacking.

The characters that have been used to distinguish "races" in species of marine fishes, such as herring and cod, are being demonstrated to result from the action of the environment on the individual during its lifetime, so that it seems doubtful whether there are heritable differences between the populations of different districts. Without such differences the use of the term "race" would seem valueless. It would be interesting to know whether the "races" of any species of Pacific salmon have been shown by rigid experiment to have differences that are heritable rather than the effect of the environment.

It has been maintained for the Atlantic salmon not only that the different rivers have more or less peculiar "races," but also that the same river may contain two different "races," one entering early and the other late in the season, although not spawning at different times. This theory has been causing the Canadian Government to spend considerable money in securing the early running fish and in keeping them till spawning time for breeding purposes, since both anglers and commercial fishermen desire the early fish not only because they are available in the fishing season, but also because they tend to be larger than the late-running fish.

As crucial a test as possible[2] was made of this theory of "races" by taking the fry of Restigouche salmon, which characteristically run early and large (ordinary salmon and big salmon) and planting them in a salmonless branch of Apple River at the head of the Bay of Fundy in the middle of a district characterized by the salmon entering the streams only late in the season and almost wholly as grilse (small salmon). The transplantation was made in 1932 by Mr. H. C. White after studying the behavior of the local fish. He followed the result during the following years, marking the Restigouche smolt when they descended to the sea in 1934 and trapping the adults during the seasons of return. The experiment was concluded in 1936. He was unable to detect any difference between the Restigouche fish and the local fish in size (year of return), in season of return or in any other character except rapidity of growth in the stream, for which the conditions were not comparable. While such a result is no proof that races do not exist elsewhere, it is evidently desirable that local populations should not be considered to be racially

[1] SCIENCE, 85: 477–478.

[2] Ann. Rep. Biol. Bd. Can., 1932, 1933, 1934, 1935 and 1936: 43, 43, 10, 8–9, and 10–11, 1933, 1934, 1935, 1936 and 1937.

istinct until heritable differences have been definitely emonstrated.

A. G. HUNTSMAN

BIOLOGICAL BOARD OF CANADA
TORONTO

PHILOSOPHY OF PHYSICS

PROFESSOR HOUSTON'S recent article[1] on the philoso- hy of physics discusses the significance of quantum echanics for the philosophical problem of the exis- ence of the external world. I believe that physical eory is neutral toward this problem, and in the fol- wing I restate a theory[2] of the relation between erception and the physical world, which provides an dequate basis for science but does not commit one o a specific philosophy.

The primary factor in science is perception. Per- eptions are found to be correlated. A perception hich belongs to a correlated set of actual and possible erceptions is interpreted to be a perception of some hysical body. A theory of physical bodies may now e expressed by two principles. The first principle is hat a physical body is a center of reference of corre- ated perceptions. That physical bodies exist is con- rmed by the discovery of functional relations between erceptions. The second principle is that the struc- ure of perceptions indicates the structure of bodies. ts precise version in physics is that the coincidence f perceptions for all observers signifies the space- ime coincidence of the events perceived. For mathe- atical exactness an event must be thought of as a pace-time point.

The neutrality of the preceding formulation may be xhibited by giving two philosophical interpretations, ualistic realism and phenomenalism. In traditional ualism a physical body is absolutely independent of xperience; it produces perceptions by acting on the bserver. The structure of bodies is indicated in per- eptions because the structure of an effect corresponds o that of the cause. In dualism the physical world s the object of a constructive hypothesis. The phe- omenalistic interpretation is that a physical body is conceptual parameter which serves to correlate erceptions; thus the physical world is the object of constructive definition. Perception exhibits the tructure of physical bodies in virtue of the mode of onstruction of the latter.

The issue between dualism and phenomenalism is ot affected by the quantum mechanical theory of easurement. In this theory measuring instruments, uch as a screen with a slit, are macrophysical bodies hich are experienced in perception by classical meth- ds. The properties of microphysical entities are etermined from their effects upon the measuring nstruments. In these determinations principles, such as those of conservation of momentum and energy, are employed to infer the properties of a microphysical entity. Now, the functional relations expressed by physical principles are to be viewed as constituents of physical reality. Hence the microphysical entity has the same kind of physical reality as the measuring instruments. If the latter are conceptual constructs to which possible perceptions are referred, so are the microphysical entities which interact with them. If the measuring instruments are independent realities in the dualistic sense, so are electrons and photons. The choice between these philosophical interpretations falls outside of physics. Indeed, some positivists hold that since the issue can not be decided by experience it is meaningless.

V. F. LENZEN

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[1] SCIENCE, n. s., 85: 413, 1937.
[2] *Nature*, 136: 433, 1935.

FURTHER DISCUSSION ON SUBMERGED CANYONS

IN the April 3, 1936, issue of SCIENCE, MacClintock and the writer advanced a hypothesis that the submerged canyons off the coasts of all continents might be the result of a change in ellipticity of sea-level. F. P. Shepard[1] criticized this hypothesis, claiming to show that it was untenable because a zero line of no change of sea-level should exist at 35° N. and 35° S. latitude. Therefore the hypothesis could not explain valleys at higher altitudes than 35°.

Shepard's reasoning contains a fallacy. Two ellipses of the same area would intersect at 35°, but the two sea-level surfaces such as we suggested would not do so. The reason for this is that there is not enough water between 35° N. and 35° S. latitude to fill the volume up to the new spheroid above 35°; therefore the new sea-level surface would be parallel to the new spheroid but considerably below it. Thus the zero line of no change of sea level might lie at 55° or 60°, as we postulated.

The writer also wishes to take exception to Shepard's statement concerning the accuracy of soundings taken by the S 48. The writer was on the S 48 when these soundings were taken, and believes the accuracy was quite sufficient for the conclusions drawn.

The writer is not at all convinced that the change in ellipticity of sea-level hypothesis is the correct explanation for the origin of the submerged valleys, but he does still consider it a *working hypothesis,* even though it may be an "outrageous" one. If a solution is to be arrived at for this complex problem, all possible hypotheses must be kept in mind and the critical data bearing on all of them collected.

H. H. HESS

PRINCETON UNIVERSITY

[1] SCIENCE, June 26, 1936.

SCIENTIFIC BOOKS

THE ORGANIC CHEMISTRY OF NITROGEN

The Organic Chemistry of Nitrogen. By NEVIL VINCENT SIDGWICK, F.R.S. New edition. Revised and rewritten by T. W. J. Taylor and Wilson Baker. The Clarendon Press, Oxford, 1937; pp. xix + 590; $6\frac{1}{2} \times 10$ in.; price, $8.50 bound.

THE new edition of this valuable treatise appears very appropriately in our own country only a few months prior to the arrival of its distinguished author, who is to deliver the Maiben lecture before the American Association for the Advancement of Science at its Denver meeting on June 23.

Since the appearance of the first edition, in 1910, the work has been recognized as an authoritative review and critical discussion of that great division of organic chemistry with which it deals. As explained at that time, the purpose of the book is primarily educational, and it is not intended in any sense as a work of reference. Hence it does not attempt to cover the whole vast domain of nitrogenous organic chemistry, but rather to select those portions which seem most important, either because of their theoretical interest or for other reasons, and to discuss these in considerable detail.

Professor Sidgwick realized many years ago that the enormous expansion of our knowledge in this field made a revision of his book highly desirable, and in 1922 began the undertaking, with the intention of enlisting the collaboration of some of his Oxford colleagues and thus making it a cooperative effort. By the close of 1933, he had completed the first draft of four of the eighteen chapters. It then became evident that the increasing duties and responsibilities of all kinds devolving upon him as the result of his selection for so many positions of honor and distinction would postpone indefinitely the completion of a task which was daily growing more difficult.

In 1934, therefore, the completion of the revision was entrusted to the capable hands of Drs. Taylor and Baker, both fellows of Oxford University, the one of Brasenose and the other of Queen's College, and the book under review is the result. In its compilation, the authors have had the benefit of the material accumulated by those other colleagues who, from time to time, had aided Professor Sidgwick.

The major grouping of the subject-matter into the four divisions—I. Compounds with no nitrogen directly attached to carbon; II. Bodies containing one nitrogen atom attached to carbon; III. Compounds containing an open chain of two or more nitrogen atoms, and IV. Ring compounds—has been abandoned, although, in the main, the chapter headings, sequence and subject-matter remain much the same. The text as a whole has been not only thoroughly revised but also largely rewritten. The book opens with an introduction by Professor Sidgwick on "The Nitrogen Atom," and "Resonance."

As compared with the first edition, the following changes will be noted: (1) the amino acids have been assigned a separate chapter; (2) the aliphatic diazo compounds and derivatives of hydrazoic acid have been removed from Division IV and now constitute Chapter XI, immediately preceding the hydrazine derivatives; semicarbazide and related compounds, formerly given in Division III, now appear with the other carbonic acid derivatives in Chapter IX; the uric acid derivatives and the pyridine alkaloids have been omitted. On the other hand, the discussion of quinoline derivatives has been considerably extended, and now includes such important topics as the cyanine dyes, reactive methyl groups, acridine and phenanthridine. In the chapter (VIII) on nitro compounds, Mr. D. L. Hammick contributed the section on the molecular complexes of aromatic nitro compounds, and Professor Sidgwick that on chelate *o*-nitrophenol derivatives.

To the literature of its field, it is an outstanding and valuable contribution, and one which should be in the library of every one interested in organic chemistry.

MARSTON TAYLOR BOGERT
COLUMBIA UNIVERSITY

LIFE HISTORIES

Criteria for the Life History, with Analyses of Six Notable Documents. By JOHN DOLLARD. Yale University Press. v and 288 pp. 1935.

IT is difficult accurately to review a book which is obscurely written. John Dollard has a large vocabulary which he uses with prolixity but without precision. For example, he quotes Adler as saying that the mother helps the child and usually pampers him, and he comments thereon (pp. 49, 51, 67) in a manner which indicates that he does not know what "pampers" means and thus misses the significance of the quotation. Again, he has a fondness for the plural noun "surrogates," but I am unable to substitute any definition of the term I have thus far found in the dictionaries for the word where he uses it. The proper use of shall and will, of should and would, is of course difficult even for a discriminating writer; yet without being too much of a purist one may feel that the readers at the Yale University Press might have clarified some of the author's sentences by querying his usage

these common words. "The 'group' into which e child comes is not the group in general; the child not born into the church or the army; rather he is rn into a very definite specification of the larger oup, namely, the family." Here the meaning is ear, despite the shock of the somewhat strange word ecification; and one is perhaps impeded rather an helped in his comprehensions of the sentence if should be unfortunate enough to think of the rites infant baptism and of circumcision, or of the intence of some large religious group that the child *is* rn into the church.

John Dollard has an exuberance of metaphor. metimes he calls it metaphor, more often he does t. "To use a football metaphor we begin in Ad-'s psychology at about the thirty yard line, rather an at the goal line, so far as the biological contribun to the development of the individual is conrned." This does not seem clear; when did the footll game begin at the goal line? Does it not begin at e forty-yard line? Would we turn from sports to ochemistry, kinematics and psychology we can ponr this: "It shows . . . the culture as coagulated ound a center of feeling . . . the life history shows center of feeling and positive motivation moving rough a culture, over time. The culture offers to is moving center of feeling its preferred barriers and rmitted exits, much as in the psychologist's maze." is difficult to believe that for any reader this maze metaphor in any way clarifies the author's meaning. e is surely trying very hard to say something, but hat, or shall I say, which?

"*Criterion II. The organic motors of action ascribed ust be socially relevant.* This criterion sounds rather fficult to understand, but this is not the case; it is ally very simple. It means merely that in order have a theory of motivation we must make some atements about the body and what it can and will ; the organic properties which we assume as the sis of the life in the individual in the group must of such a kind that they will submit to social aboration. The organic activities of the body must me to meet the social influences that we have deribed."

This, dear reader, appears to be the definition of e of the seven fundamental criteria which a life story must satisfy. The first sentence after the alics should be unnecessary if true; but let us be aritable and thank the author for encouraging us oor boneheads along. What, then, do you make of e next two sentences? Unhappily, I make little of em or of the following three pages of exposition of is "really very simple" matter, and I regret to y that after examining the application of the cririon to the six life histories analyzed by Dollard I am still at a loss to know what he means, if anything. In the first case history (p. 45) he writes: "Adler rejects inherited or inheritable traits as a necessary concept and sees the new born infant as completely and plastically accessible to social influence. In this he would seem to be quite in accord with the best results of the comparative study of culture." This is a strictly anti-hereditarian point of view. Yet somehow the whole aim of Criterion II seems to be to lay stress on the organic; it is at any rate the only criterion of the seven which deals with the body and what it can and will do. Of course if one distinguishes temperament and personality, including in the former everything that can be inherited and in the latter only that which is not inherited but is taken on by exposure to the culture, then, irrespective of the best results of the comparative study of culture, one rejects *by definition* the concept of inheritance in the study of personality—and if so, why not say so clearly, even bluntly.

This is indeed what Thomas and Znaniecki, as quoted by Dollard, seem to do: "We may call temperament the fundamental original group of attitudes of the individual as existing independently of any social influences; we may call character the set of organized and fixed groups of attitudes developed by social influences operating upon a temperamental basis . . . the development of temperamental attitudes into character-attitudes can assume many different directions, so that, if proper influences were exercised from the beginning, a wide range of characters, theoretically any possible character, might be evolved out of any temperament." This is tolerably definite. The biologist would probably object to so extreme a statement as "theoretically any possible character," but that might depend on how restrictive is the qualification "the set of organized and fixed groups of" applied to attitudes in the definition of character. At any rate, Dollard, writing after Thomas and Znaniecki, should be equally or more precise than they, whether he follows or modifies their definitions.

What Dollard is trying to do is to unite the notions of psychologist, anthropologist and sociologist in such manner that he may reach a specification of characteristics of the life history which shall be necessary and sufficient to make it define the growth of a person in a cultural milieu so that the life of the individual up to any particular point may be viewed as a connected whole, shall make theoretical sense as a unit and shall afford the basis for prediction of behavior immediately beyond that point. This is an ambitious project. To accomplish even initial stages in the development of such a difficult undertaking it is important to be discriminating in thought, straightforward in exposition, clear in phraseology. That is why I have laid

so much emphasis on his failure in these respects. He has shown that his criteria are not satisfied for the life histories he has examined, and presumably he has chosen for examination the best available. He may thus have made a real contribution to the improvement of future life histories, even though the work as a whole, especially in its all too freque "asides" and in its exuberance of mixed metaphor, e hardly fail to impress any mature student as ado lescent.

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SOCIETIES AND MEETINGS

THE ILLINOIS STATE ACADEMY OF SCIENCE

THE thirtieth annual meeting of the Illinois State Academy of Science was held at Rockford College, Rockford, Illinois, on May 7 and 8. The attendance at the meetings, including the sessions of the Junior Academy, which held meetings of its own at the Rockford Senior High School, was well over 1,000.

For the program at the general session on Friday morning, after an address of welcome by Dr. Gordon Chalmers, president of Rockford College, Professor C. L. Furrow, Knox College, Galesburg, president of the academy, gave an illustrated lecture on "The Evolution of Sex in the Mollusca." This was followed by an address by Mr. Don L. Carroll, of the State Geological Survey, Urbana, on "Some Observations on the 1937 Flood in Southern Illinois." This address was illustrated by lantern slides of aerial photographs and maps of the area. The final address of the Friday morning session was a lecture, illustrated by colored moving pictures, on "Science and the Garden" by Mr. John H. Hanley, University of Illinois, Urbana. The Friday morning session of the Junior Academy was given over to the display and judging of the projects which were presented for competition in the annual exhibition of projects. For the general session on Friday evening Professor H. A. Vagtborg, of the Armour Institute of Chicago, addressed the Junior Academy members and guests on the topic "The Story of Sanitation." Professor George W. Stewart, head of the department of physics of the University of Iowa, addressed the Senior Academy on the subject, "Changes in Concepts of States of Matter."

On Friday afternoon 145 papers were presented before nine sectional meetings. The activities of the academy for the Saturday sessions consisted of six field trips. These were especially well attended. The geological trip, under the direction of Dr. M. M. Leighton, chief of the State Geological Survey, Urbana, and of Dr. George E. Ekblaw, also of the State Geological Survey, visited points of geological interest in the vicinity of Rockford. An industrial trip, under the sponsorship of the Rockford Chamber of Commerce, visited some of the many interesting industrial plants at Rockford. A trip to the Rockford Sewage Disposal Plant was conducted under the leadership of Mr. T. G. Lindquist, superintendent of the Sanitary District o Rockford. An anthropological trip, with Dr. J. B Ruyle, of Champaign, as leader, visited the Loga Museum of Beloit, Wisconsin, and studied the vario kinds of Indian mounds in the vicinity. A trip und the leadership of Mrs. J. H. Mansfield, president of th Rockford Garden Club, visited some of the many fin residential gardens of Rockford, the public parks an the nine forest preserves of Winnebago County. Th botanical trip, under the direction of Dr. H. W Pepoon, Chicago, and Dr. George D. Fuller, of th University of Chicago, visited and studied the interes ing flora of Apple River Canyon State Park.

The officers elected for the year 1937–38 are:

President, Harold R. Wanless, geology, Universi of Illinois; *First Vice-President,* George D. Fulle botany, University of Chicago; *Second Vice-Preside and Chairman of Committee on Local Arrangement* Otis B. Young, physics, Southern Illinois State Norm University; *Secretary,* Wilbur M. Luce, zoology, Un versity of Illinois; *Treasurer,* Paul D. Voth, botan University of Chicago; *Editor,* Dorothy E. Rose, geol ogy, Illinois State Geological Survey.

The annual meeting for next year will be held a the Southern Illinois State Normal University, Car bondale, Illinois, on May 6 and 7, 1938.

WILBUR M. LUCE,
Secretary

THE NEW HAMPSHIRE ACADEMY OF SCIENCE

THE nineteenth annual meeting of the New Hamp shire Academy of Science was held on May 28 and 2 at Colby Junior College, New London. The Frida evening session was devoted to the reading of paper by members, the principal one of which was "Physi ography of the Mt. Washington Region," by Mr Richard P. Goldthwait, of Harvard University, wh has been working on the problem with the aid of grant from the academy and from the American Asso ciation for the Advancement of Science.

Papers by members were read at the Saturday morn ing session. Professor Charles F. Brooks, directo of the Blue Hill Observatory, Harvard, and of th Mt. Washington Observatory, reported on the wor done at the Mt. Washington Observatory during th

past year, including the special studies aided by an academy grant from the American Association.

At the Saturday afternoon session following the business meeting the presidential address, "Vertebrate Evolution—A Record and Some Implications," was given by Professor George M. Robertson, of Dartmouth College.

At the business meeting it was announced that the council had recommended the awarding of the grant for the current year from the American Association for the Advancement of Science to Dr. Henry I. Baldwin, of the State Forestry Department, for assistance in compiling and publishing "A Flora of the Fox Research Forest." The committee on conservation, of which Mr. Laurence W. Rathbun, chief forester of the Society for the Preservation of New Hampshire Forests, is chairman, made a report of its activities and presented plans for further work.

The following officers were elected for 1937–38: *President,* Professor Karl W. Woodward, University of New Hampshire; *Vice-president,* Dr. Henry I. Baldwin, research forester, State Forestry Department; *Secretary-Treasurer,* Professor George W. White, University of New Hampshire; *Member of the Executive Council,* Professor George M. Robertson, Dartmouth College; *Councillor to the American Association for the Advancement of Science,* Professor Walter C. O'Kane, University of New Hampshire.

George W. White,
Secretary

SPECIAL ARTICLES

THE BEHAVIOR OF CERTAIN DUSTS[1] UNDER MECHANICAL[2] IMPINGEMENT

One type of method for the examination of the dustiness of the air depends on the mechanical impingement of a known volume of the dust-laden air at a considerable velocity on a dry or wetted surface. From the number of dust particles found on a limited area of the dry surface or in a certain volume of the wetting liquid the number of dust particles in a unit volume of the sampled air is calculated. The possibility of breakage of the dust particles due to their force of impact on the impingement surface has been suggested from time to time, but as far as the writers know no investigations on this point have ever been published. If breakage did occur there would be more particles formed than were originally present, and furthermore a particle size determination on the resultant particles would show greater numbers in the smaller sizes than were present in the air.

So far we have used only three dusts in our experiments. Finely ground orthoclase feldspar and quartz were classified by settling in a mixture of water and ethyl alcohol. This method of classification has been described in detail by Cummings.[3] The fraction of each dust between 5 and 10 microns was resettled five times to remove adhering "fines." The third dust used was dried spores of pencillium oxalicum. The spores are uniform in size, averaging 2 microns in diameter by 4 microns in length.

Behavior of the three dusts under various conditions are given in Table 1.

TABLE 1

	Impinging velocity[4] meters per second	Conditions of impingement	Ratio of smaller particles to particles of original size (approx.)	Average dimensions of shattered particles microns
Feldspar	40 ± 10	Dry surface of gelatine and glycerine	4.5 : 1	1.0–1.5
Feldspar	70 ± 10	Dry glass plate[5]	100 : 1	1.0 and less
Feldspar	100 ± 10	Dry glass plate	100 : 1	1.0 and less
Feldspar	150 ± 10	Glass plate submerged in water	50 : 1	1.5 and less; considerable ultra-microscopic material
Pen. Oxal.	40 ± 10	Dry surface of gelatine and glycerine	0 : 1	None shattered
Pen. Oxal.	70 ± 10	Dry glass plate	0 : 1	None shattered
Pen. Oxal.	100 ± 10	Dry glass plate	0 : 1	None shattered
Pen. Oxal.	150 ± 10	Glass plate submerged in water	0 : 1	None shattered
Quartz	40 ± 10	Dry surface of gelatine and glycerine	3 : 1	1.0–1.5
Quartz	70 ± 10	Dry glass plate	25 : 1	1.0 and less
Quartz	100 ± 10	Dry glass plate	50 : 1	1.0 and less
Quartz	150 ± 10	Glass plate submerged in water	50 : 1	1.5 and less; considerable ultra-microscopic material

[1] The term "dust" is used to denote solid particles 0.5 to 10 microns in longest dimension.

[2] The term "mechanical" is used to denote a force caused mechanically rather than thermally or electrically.

[3] D. E. Cummings, *Jour. Ind. Hyg.*, 245–56, 1929.

[4] The velocities given above were obtained by dividing the volume of air sampled in a unit time by the area of

From the data in Table 1 it is concluded:

(1) The composition of the dust is a factor in the amount of crushing under mechanical impingement.

(2) The velocity of impact as well as the surface on which and the medium in which the impact occurs has a bearing on the amount of crushing.

(3) With the exception of impingement on a wetted surface, the smallest particles noted were on the order of a micron. It appears, therefore, there is a limit to the fineness that a particle will shatter at definite velocities and conditions.

(4) In the case of impingement on a wetted surface considerable material below 0.5 micron was noted. It may be that this was formed by attrition of the water-borne particles by other particles in the incoming air stream.

(5) In all cases of dry impingement a variable amount of scattering of particles outside of the field of impingement was seen. This indicates incomplete retention of these dusts on the impingement surfaces.

(6) With two of the three dusts any estimation of particle size distribution in the air from the resultant particles is erroneous.

(7) With each of the three dusts examined an estimation under the above conditions of the number of particles in the air sampled is erroneous.

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OVULATION INDUCED OUT OF SEASON

OVULATION has been induced in a variety of Amphibia during the non-breeding season by the injection of the anterior pituitary hormone. Since the original description of the technique of inducing ovulation and of artificially inseminating eggs of the frog, *Rana pipiens*,[1] there have been a number of refinements so that now one can count on securing fertilized eggs and developing tadpoles at any time of the year from early September until the normal breeding season, in March. From March until July, *Rana clamitans* can be used, and *Rana catesbeiana* (the bullfrog) will respond to pituitary-induced ovulation until late in August. *Acris gryllus* normally breeds from February to October, and *Rana sphenocephala* from February to December. With inhibition of normal ovulation by refrigeration, amphibian eggs may be available for twelve months of the year. The technique, as now used, will be briefly described.

With few exceptions, *Rana pipiens* can not be co[…] sidered sexually mature unless it measures 74 mm fr[…] snout to cloaca. Frogs are secured from one of th[…] frog farms and are placed immediately in a copp[…] lined tank in the refrigerator, through which run[…] slow stream of water. Frogs may be kept at this te[…] perature (about 4 to 6° C.) for several weeks wi[…] out showing gonadal deterioration. Twenty-four hou[…] before eggs are desired an obviously mature femal[…] is injected with whole anterior pituitaries from t[…] adult female or four adult male frogs. Mammali[…] or fish pituitaries have not been successfully used wi[…] frogs in inducing sexual reactions, but such pituitari[…] will induce ovulation and amplexus in toads and bree[…] ing reactions in salamanders. Amphibian pituitari[…] will, in general, induce such reactions in *Rana pipie[…]*

It has been found that the average male anteri[…] pituitary (*Rana pipiens*) is 16 per cent. heavier a[…] 60 per cent. as potent as the average female gland i[…] respect to inducing ovulation. The glands must b[…] quickly excised, as they rapidly lose their potency i[…] dead frogs. If the head is cut off; the lower jaw r[…] moved; the base of the cranium cut along each side [...] the brain; the parasphenoidal bone deflected forwa[…] the anterior pituitary gland will be seen as a pi[…] organ lying just posterior to the optic chiasma. Occa[…] sionally it will adhere to the base of the cranium a[…] will be surrounded by white endolymphatic tiss[…] which has no apparent sex hormone value. T[…] pituitary is placed in 1 cc of distilled water, 35 p[…] cent. alcohol or Ringer's solution. Generally 1 cc [...] fluid is used per gland, partly as a check on the numb[…] of glands used. When the proper number of gla[…] has been secured, they are sucked up into the barrel [...] a hypodermic syringe, with no attempt to macera[…] the pituitaries. It has been found that the fresh gla[…] will easily pass through a No. 20 hypodermic nee[…] and that if the gland is previously macerated, some [...] the hormone is lost by adhesion to the inner sides [...] the syringe. The needle is applied to the syringe a[…] injected through a lower quadrant of the abdom[…] avoiding deep penetration and consequent danger [...] internal injury. Immediately following injection t[…] frog is placed in a container with enough water [...] partly immerse the body. If amplexus and nor[…] fertilization are desired, a male may be similarly i[…] jected and amplexus will be achieved in about 9 to [...] hours at ordinary laboratory temperatures of [...] 25° C. In this case only pond or spring water, or [...] per cent. Holtfreter's[2] modification of amphibi[…] Ringer's can be used, since tap water is generally le[…] to sperm.

If insemination is to be controlled, the female sho[…]

the impingement orifice. The actual velocities at the surface where impingement takes place are of necessity lower, due to mechanical design.

[5] In all cases using a dry glass plate, the dust-laden air was previously humidified by passage through a tube containing moisture.

[1] R. Rugh, *Biol. Bull.*, 66: 22, 1934.

[2] J. Holtfreter, *Arch. f. Ent. Mech. der Org.*, Bd. 1[…] S. 404, 1931.

be kept isolated and 24 hours after injection should be tested (gently stripping) to determine whether eggs have reached the uteri. A sperm suspension (males need not be injected[3]) is made by teasing apart two pairs of testes in 10 cc of spring or pond water. It is very important to use only water in which sperm are known to survive. After about 30 minutes' standing, this sperm suspension is ready and eggs may be stripped directly into it. It is best to divide the suspension between two finger bowls and to spread the eggs out thinly in the sperm suspension. After half an hour the eggs are flooded with the same water used for the sperm suspension. When the jelly has swollen (about an hour more) the eggs should be distributed so that there are about 25 to 50 eggs per finger bowl full of water. In this manner 100 per cent. fertilization and development can be achieved under controlled conditions.

If a female is injected with the anterior pituitary hormone and is kept at 22°–25° C. it can be used in 14–16 hours to demonstrate all of the reproductive processes from follicle rupture to entrance of the egg into the uterus.[4] Such a frog should be anesthetized, opened, and the entire body submerged in 10 per cent. Holtfreter's solution. Ovarian contractions will be clearly seen. Numerous follicles will be observed to rupture and the eggs emerge, a process which takes from 4 to 10 minutes for a single egg. Free eggs will be picked up and carried toward the ostiae by peritoneal, pericardial and liver cilia. Eggs enter the ostium singly, entirely as a result of ciliary action. They are carried through the oviducts (about 2 hours) in a spiral manner, by ciliary currents. Eggs can be fertilized from any point within the oviduct but not from the body cavity. This situation is a challenge to further research on the mechanism of fertilization.

It has recently been demonstrated[5] that the dose of the anterior pituitary required to induce ovulation decreases appreciably in the period between November and February. This is explained on a three-fold basis: the potency of the donor's gland increases as the breeding season approaches; the gland of the recipient may begin the elaboration of the hormone toward the end of hibernation; and the ovaries may be differentially susceptible to stimulation at different periods.

The anterior pituitary is readily soluble in water and alkaline solutions. It can be kept in aqueous solutions for several days in the refrigerator. If kept in 70 per cent. alcohol the potency will remain practically unaltered for several weeks, and if kept in 100 per cent. alcohol, where none of the hormone is dissolved, the potency remains indefinitely. Recent tests have indicated normal potency after one year in absolute alcohol. In this latter case, however, the alcohol must be diluted with distilled water until a 35 per cent. solution (or less) is achieved before injection.

The frog's anterior pituitary is so small (0.6 to 1.5 mgm) that extraction of the hormone would entail great loss. Preservation of the entire gland is indicated. In most laboratories many frogs are sacrificed for a single muscle or nerve experiment and the anterior pituitary glands of such frogs may be excised and saved for ovulation induction during non-breeding seasons. There is evidence that this technique, with modifications, may eventually be used on a variety of animal forms which will yield valuable embryological material.

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[3] R. Rugh, *Proc. Soc. Exp. Biol. and Med.*, 36: 418, 1937.

[4] R. Rugh, *Jour. Exp. Zool.*, 71: 149, 163, 1935.

[5] R. Rugh, *Physiol. Zool.*, 10: 84, 1937.

HOMOTRANSPLANTATION OF ADRENAL CORTICAL TISSUE

IN 1932[1] we reported successful intramuscular homotransplantation of adrenal cortical tissue between albino rat litter mates (100 per cent. in four male rats). We also showed that both autoplastic and homoplastic transplants would grow in the same animal at the same time, there being no "preference" for either type of tissue (40 per cent. successful homotransplants in 10 male litter mates. Martin (1932)[2] also reported three successful homoplastic intraovarial transplants. Nilson and Ingle (1936)[3] reported that intra-ovarial homotransplants in sisters were successful, but that "direct homoplastic transplants of the adrenal glands of adult rats" and cross-strain transplants degenerated.

In connection with other problems it became necessary for us to attempt intramuscular homotransplantation of adrenal glands between non-siblings of our inbred strain of rats. The adrenal glands were exchanged between five pairs of females, three pairs of males and four pairs of a male and female each (24 rats). The members of each pair were not only non-litter mates but were from different parents. Twelve animals died of suprarenal insufficiency. The twelve survivors were killed and the grafts examined histologically from two to four months after operation. The homotransplants had regenerated and were functioning (as testified by the good health of the animals) in eight of the ten females which had received tissue from other females, in two of the four females which had received tissue from males, and in only two of

[1] L. C. Wyman and C. tum Suden, *Am. Jour. Physiol.*, 101: 662–667, September, 1932.

[2] S. J. Martin, *Am. Jour. Physiol.*, 100: 180–191, March, 1932.

[3] H. W. Nilson and D. J. Ingle, SCIENCE, 84: 424, November, 1936.

the males. One of these had received tissue from another male and the other from a female. The sex of the donor, therefore, has no particular bearing on the success of non-sibling homotransplants. The sex of the recipient seems to be significant, since over 71 per cent. of the females regenerated homotransplants, whereas only 20 per cent. of the males did so.

Successful homotransplantation of adrenal cortical tissue between non-siblings of the same strain is possible. Obviously, if a large number of "takes" is desired in such experiments females should be used. We have evidence, which will be published elsewhere, that the growth of transplanted cortical tissue in rats is determined and limited by the available adrenotropic hormone from the anterior lobe of the hypophysis. The larger percentage of "takes" in females reported here may depend on a greater amount or greater availability of adrenotropic hormone in females. Such an explanation is consonant with the well-known facts that female rats have larger adrenal cortices than males, and that females regenerate more cortical tissue in transplants or "accessories" than do males.

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IMMUNITY OF CERTAIN INSECTS TO SELENIUM POISONING

A LOW concentration of selenium in foodstuffs is a quick-acting lethal poison for mammals and birds, and small quantities of this element absorbed from the soil are responsible for toxicity of grains and forage plants to live stock.[1] Insects also are regarded as very sensitive to selenium. Aphids are killed by concentrations in wheat plants too low to injure the plants themselves,[2] and red spiders are quickly destroyed by commercial insecticides containing selenium.[3]

We were surprised, therefore, to find weevils and seed-chalcids completing their life cycles in the seeds of one of the most poisonous of the range plants, *Astragalus bisulcatus* (collected near Laramie, Wyoming). Analysis showed that the seeds contained 1,475 parts per million of selenium. The weevils were identified by Mr. H. S. Barber as *Acanthoscelides fraterculus* (originally reported from Kansas, Nebraska and Colorado) and the seed-chalcids—small wasp-like insects—were identified by Mr. A. B. Gahan as *Bruchophagus mexicanus* or a closely related species. A s ond hymenopterous insect, *Amblymerus bruchoph* less numerous than the first, was present as a para of the seed-chalcid.

The high toxicity of the seeds to mammals shown in an experiment in which five white rats fed on a mixture containing ground pods and seeds a similar *Astragalus* plant. Although the selen content of the food was reduced by dilution ground wheat to only 65 ppm, the rats were ki within from 4 to 11 days. Even 22 ppm of seleni in the diet is lethal to young, developing rats;[4] grains and fodder containing less than 50 ppm selenium absorbed from the soil have been repor to cause the death of hogs, cattle and horses.

The *Astragalus* plants, though rooted in soil wit selenium content of only about 3 ppm, are able accumulate from 1,000 to 9,000 ppm.[5] The developi weevil larvae present a striking contrast: Althou their food contained 1,475 ppm of selenium, the lar either did not absorb it readily or they eliminated effectively, perhaps through their respiration. Anal sis of their bodies showed the presence of only 65 p of selenium.

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[1] For literature review, see S. F. Trelease and A. L. Martin, *Bot. Rev.*, 2: 373–396, 1936.

[2] A. M. Hurd-Karrer and F. W. Poos, SCIENCE, 84: 252, 1936.

[3] C. B. Gnadinger, *Indust. Eng. Chem.*, 25: 633–637, 1933.

[4] A. L. Martin, *Amer. Jour. Bot.*, 23: 471–483, 1936.

[5] O. A. Beath, H. F. Eppson and C. S. Gilbert, *Wy Agric. Exp. Sta. Bull.*, 206, 1935.

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